Basic Embedded Generator (EG) Connection Technical Requirements

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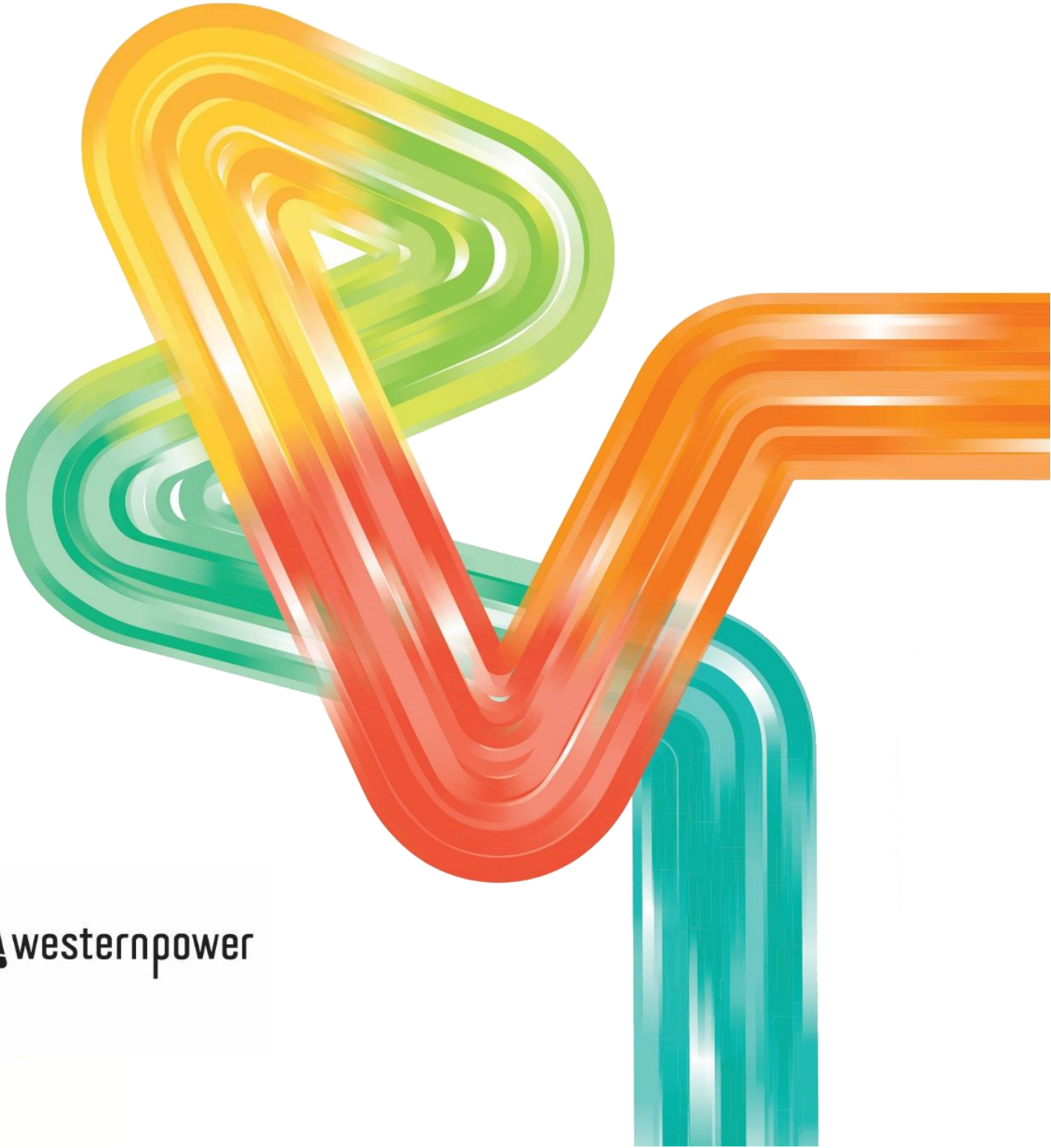

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Document Information

Title	Basic Embedded Generator (EG) Connection Technical Requirements

Authorisation

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A	14/10/2021	Nigel Wilmot	Initial version
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Glossary

Term	Definition
AC Coupled	The terminology used by industry in relation to battery storage systems includes terms AC coupled. Sometimes AC coupled systems are referred to as AC batteries. The term coupled refers to where the battery is connected into an IES. AC coupled refers to connection of energy sources on the AC electrical installation using inverters to control operation of the storage and interaction with other energy sources
Authorised Agent	A User with an Electricity Transfer Access Contract with Western Power that is responsible for electricity supplied to another User and that have the permission to control the User's EG system for DER management.
Basic EG system	An embedded generator suitable for connection to Western Power standard connection services that meet requirements of the Basic EG Technical Requirements
battery energy storage system	As defined in AS/NZS 5139 2019
connection agreement	An agreement or other arrangement between the Network Service Provider and a User, which may form part of or include an access contract that specifies the technical requirements that apply in relation to the connection of a User's equipment to the transmission or distribution system (refer Western Power Technical Rules)
connection point	As defined in WASIR
DC coupled	DC coupled refers to energy sources that are connected onto a DC bus (or terminations) of an inverter.
DER	Distributed Energy Resources are smaller–scale devices that can either use, generate or store electricity, and form a part of the local distribution system, serving homes and businesses. DER can include renewable embedded generation such as rooftop solar photovoltaic (PV) systems, energy storage, electric vehicles (EVs), and technology to manage demand at a premise
Disconnect/reconnect	The operation of disconnecting or reconnecting an inverter in an EG System from the grid for the purposes of DER management
EG system	An embedded generation system is a form of DER connected within a User facility
export limit	Permitted level of power (kW) allowed to be transferred from User generation to the grid through the User connection point
generation limit	Permitted maximum generation apparent power (kVA) within a User installation where aggregate capacity of all inverters exceeds permitted maximum generation
Informative	Parts of this technical requirement that are information only
inverter energy system	As defined in AS/NZS 4777.1 2016
Large networks	Most common type of network arrangement and includes all the three-phase 415V low voltage distribution networks. Typically, this includes the metropolitan area and country city centres. The standard network nominal voltage is 415V three-phase (line to line) and 240 V single-phase (line to neutral).
may	The word 'may' indicates an action or practice that is permitted without affecting other requirements

Modbus TCP	MODBUS TCP/IP is a variant of the MODBUS family of simple, vendor-neutral communication protocols intended for supervision and control of automation equipment.[1]
Multi-phase	Used where either a split-phase or three-phase connection may be available
Normative	Parts of this technical requirement that form part of the mandatory technical requirements of this document
Off-take agreement	This is a commercial agreement between the User and their connection point energy retailer to purchase exported energy into the grid from their EG system
shall	The word 'shall' indicates a mandatory requirement Notes to tables and figures with 'shall' requirements are mandatory part of this document
should	The word 'should' indicates a recommendation requirement that will not be mandatorily imposed on the User.
Single-Phase	Connection with an active of an individual phase and the neutral
Small networks	Typically, small semi-rural lots, rural lots and larger properties outside of the metropolitan area and outside of country city centres. The small network nominal voltage is 240 V single-phase (line to neutral) and 480 V split phase (line to line). Include any of the following: i. LV distribution transformers less than 60 kVA; ii. Single-phase 240 V LV networks; and iii. Split phase 240/480V LV networks.
Split-phase	Connection using two active conductors and the neutral from a single-phase transformer with a central tapped neutral. The two actives referenced to the neutral have 180° phase angle separation from each other. In some situations, a phase-to-phase connection is used to provide higher voltage capacity supply. Sometimes may be referred to as a 240V/480V supply. Also known as a two-phase connection in some circumstances
Standard connection service	As defined in the WA Service and Installation Requirements for Western Power
System capacity	The rated capacity of the inverters energy system/s that are used in the Basic EG system
Three-phase	Connection with three active phases and the neutral
Two-phase	See split-phase
Upgrade/d	Where an EG system that is already installed is being modified such that the system capacity is increased or system components are being modified, changed or added to
User	For the purpose of this document, a person with an existing or new connection point who seeks access to spare capacity or new capacity on the network involving an Embedded Generator (the relevant owner, operator or controller of the Embedded Generator (or their agent))
Voltage stabilisation devices	Any device that conditions the voltage received from the grid into the User electrical installation and alters the voltage level within the electrical installation

[1] From https://www.rtautomation.com/technologies/modbus-tcpip/ (referenced 21/4/21)

Wi-Fi	A form of wireless communications

Abbreviations

The following table provides a list of abbreviations and acronyms used throughout this document. Defined terms are identified in this document by capitals.

Term	Definition
BESS	Battery Energy Storage Systems
DER	Distributed Energy Resources
DSO	Distribution System Operator
EG	Embedded Generation
HV	High Voltage – Voltages greater than 35kV
IES	Inverter Energy System
LV	Low Voltage – Voltages less than 1 kV
MV	Medium Voltage – voltages greater than 1kV up to 35 KV
PV	Photovoltaic
SGD	Secure Gateway Device
SPS	Stand-alone power system
VDRT	Short Duration Undervoltage Ride-through
VPP	Virtual Power Plant
WASIR	WA Service and Installation Requirements
xlpe	Type of cable insulation - Cross-linked Polyethylene

1. Introduction

1.1 Purpose and scope

The purpose of this document is to provide Users of basic embedded generation (**EG**) connections, information about their obligations for connection to, and interfacing with Western Power's low voltage (LV) distribution network. Western Power endeavours to provide equitable access to the network for all Users such that Users with equivalent standard connection services have consistent EG system requirements.

This includes all User connected EG, regardless of whether such systems export electricity into the electricity system or not.

This document applies to new connections of **basic EG systems** inclusive of alterations and modifications to existing basic EG systems, where the basic EG system consists of one or more inverter energy system (**IES**). Basic EG systems are intended for installation on User connections that are categorised as standard connection service (refer to section 2.2). A basic EG system may be installed at a User connection that has a larger capacity than a standard connection service.

A basic EG System consists of an **IES** and compatible energy sources as envisaged by AS/NZS 4777 series of standards, which include renewable energy sources such as solar PV, wind and mini hydro and can include battery energy storage systems (**BESS**). The User's connection application shall identify each type of energy source per connection.

A basic EG system with a system capacity as listed in Table 1.1 is an EG system that is:

a. intended to be connected to, and capable of operating in parallel with, any part of the LV distribution network;

b. involving minimal or no augmentation of the distribution network; and

c. meeting all other technical requirements set out in this document

Table 1.1: Distributed Energy Resources (DER) EG capacity and technical requirement documents

Connection Type	Connection Voltage	Technology Type	Capacity [1]	Relevant document
Basic EG Connection	Up to 1 kV	Inverter Energy Systems without BESS	≤ 15 kVA 3Ø ≤ 5kVA 1Ø	This document
		Inverter Energy Systems DC Coupled with BESS	≤ 15 kVA 3Ø ≤ 5kVA 1Ø	
		Inverter Energy Systems AC Coupled with BESS	≤ 30 kVA 3 Ø (15 kVA IES and 15 kVA BESS) ≤ 10 kVA 1Ø (5 kVA IES and 5 kVA BESS)	
LV EG connection	Up to 1 KV	All LV EG not covered by "this document"	≤ 1 MVA	LV EG Connection Technical Requirements[2]
HV EG Connection	> 1 kV	All EG	≤ 5 MVA	HV EG Connection Technical Requirements[2]

Notes:

(1) refer to Section 4.2

(2) Specific LV and MV EG connections technical requirements are in development.

This Document is applicable to single-phase, three-phase and split-phase connection arrangements. For key criteria of single-phase, three-phase and split-phase connections, refer to the Western Australian Electrical Requirements (WAER) and Western Australian Service and Installation Requirements (WASIR).

This document supersedes the requirements for Inverter Embedded Generators connected to standard supply arrangements[2] (these are now referred to as basic EG systems) as indicated in the Western Power "Network Integration Guideline-Inverter Embedded Generation" and the "Battery Inverter Energy Systems Requirements" documents. This document supersedes previous versions and documents and comes into effect and is mandatory from the publication date, unless otherwise stated at specific clauses.

1.2 Obligations of the User

The User shall comply with all the applicable requirements of this document. Users shall:

a. obtain consent from their energy retailer for connection of the basic EG System;

b. obtain consent from Western Power before interconnecting their basic EG System with Western Power's Distribution Network;

c. comply with the technical requirements as well as relevant national standards, industry codes, legislation, and regulations. In the event of inconsistency, the order of the following instruments shall prevail, being legislation and regulations, followed by the technical requirements, followed by national standards and industry codes;

d. comply with the "Conditions of approval to connect an inverter energy system" provided to user at application preliminary approval and published on the Western Power website at date of installation;

e. not connect additional inverters, make modifications, or install additional basic EG Systems, including Battery Energy Storage Systems (BESS), without the prior written agreement of Western Power;

f. Provide relevant and requested system data after installation at completion of system commissioning; and

g. Only operate the basic EG system after receipt of approval to operate (ATO) from Western Power.

Western Power may, at its absolute discretion and without limiting any of its other rights, reject an application and/or disconnect the EG system from the grid if the User's EG system does not comply, or no longer complies with all the requirements for basic EG systems through modification being made to the User's EG system.

[2] Standard Supply arrangements in the Network Integration Guideline are referred to as Standard Connection Services in this document

2. Network and user connection categories

2.1 Network Categories

Western Power has categorised the topologies of all the low voltage networks (415V and 240V nominal voltages) as follows:

a) Large networks – includes all the three-phase 415V low voltage distribution networks.

Note: Typically, this includes the metropolitan area and country city centres. The standard network nominal voltage is 415V three-phase (line to line) and 240 V single-phase (line to neutral).

b) Small networks – include any of the following:

(i) LV distribution transformers less than 60 kVA;

(ii) Single-phase 240 V LV networks; and

(iii) Split phase 240/480V LV networks.

Note: Typically, small semi-rural lots, rural lots and larger properties outside of the metropolitan area and outside of country city centres. The small network nominal voltage is 240 V single-phase (line to neutral), 415V three-phase (line to line) and 480 V split-phase (line to line). Areas supplied by Western Power micro grids are also considered small networks.

Basic EG System connections are permitted on small networks, however they will be subject to technical reviews and potential for augmentation of the User connection or potential reduction of system size and/or export limit.

Users that may have a Western Power stand-alone power system (**SPS**) connection service shall request the special technical requirements to integrate an EG System with the Western Power stand-alone power system.

2.2 Standard connection services

The Table 2.1 provides characteristics of the Western Power Standard connection service that shall be used by User to determine the requirements for a basic EG System connection.

Table 2.1: Standard connection services (as defined in WASIR)

Connection service	Capacity (per Phase)	Nominal voltage
Single-phase	63 A	240 V
Three-phase	32 A	415 V
Split-phase(1)	32 A	480 V (Phase to Phase)

Notes:

(1) Split-phase (or two-phase) are connection types located on small networks only.

3. Relevant Rules, Regulations, Standards and Codes

3.1 Standards and Codes

This section lists the Australian and International standards (Table 3.1) and industry codes (Table 3.2) that shall apply to the design, manufacture, installation, testing and commissioning, and operation and maintenance of all plant and equipment for basic EG system connections to the distribution network.

In the event of any inconsistency between Australian and International standards, industry codes and Western Power's technical requirements, the Western Power technical requirements shall prevail.

Table 3.1: Reference Australian and International Standards

Reference	Title
AS/NZS 3000	Electrical Installations (Wiring Rules)
AS/NZS 4777.1	Grid Connection of Energy Systems via Inverters
AS/NZS 4777.2	Grid Connection of Energy Systems via Inverters
AS/NZS 5033	Installation and Safety Requirements for Photovoltaic Arrays
AS/NZS 5139	Electrical Installations – Safety of Battery Systems for use with Power Conversion Equipment
AS IEC 62116	Utility-Interconnected Photovoltaic Inverters – Test Procedure of Islanding Prevention Measures

Notes:

(1) Additional Australian or International standards apply as listed or referenced by the standards listed in this table.

Table 3.2: Western Power documents and relevant Codes

Reference	Title
WASIR	WA Service and Installation Requirements
TR	Western Power Technical Rules
WADCM	WA Distribution Connection Manual (superseded by the WASIR on 1/8/2021)
DCCR	Distribution Customer Connection Requirements

Notes:

(1) Additional Western Power documents/requirements, Australian or International standards apply as listed or referenced by the documents and codes listed in this table

3.2 Legislation and Regulation

This section provides a list of all the relevant legislation and regulations that shall apply to the design, manufacture, installation, testing and commissioning, and operations and maintenance of all plant and equipment for basic EG system connections (refer Table 3.3).

In the event of any inconsistency between legislation and regulations and the Western Power technical requirements, the legislation and regulations shall prevail.

Table 3.3: Legislation and Regulations relevant to basic EG Systems

Legislation
WA Electricity Act 1945
WA Electricity Licensing Regulation 1991
WA Electrical Requirements (WAER)
Electricity industry Act 2004
WA Electricity Industry (Code of Conduct) Regulations 2005
WA Electricity Industry (Metering) Code 2012
Energy Operators (Power) Act 1979

4. Technical Requirements

4.1 General

All Basic EG systems that are operating in parallel with the LV distribution network whether they are exporting, partial-exporting or non-export systems, shall comply to all technical requirements of this Document. The technical requirements set out in this document shall apply to all subcategories of Basic EG system connections to the Western Power grid.

Where there are multiple EG systems at a premise or sites connected to a single connection service, the system capacity will consider the aggregate of the existing and proposed EG systems at the connection point. This applies to sites such as but not limited to strata lots, retirement villages and commercial units.

For connection services with capacity larger than the standard connection service and EG Systems larger than maximum capacities of section 4.2, the User shall use the LV EG connection technical requirements to determine requirements.

Where Users intend to modify or upgrade their existing system, their complete basic EG system will be required to comply with the Basic EG Connection Technical Requirements (this document) and meet their obligations outlined in Section 1. Users are required to submit an application to Western Power prior to the modification or upgrade being commenced.

All Basic EG systems shall be installed as per the arrangement drawings in the Distribution Customer Connection Requirements (DCCR).

4.2 Maximum Basic EG System Capacity for Connection Services

4.2.1 General

The maximum system capacities of Table 4.1 and Table 4.2 shall be used by Users to determine the maximum basic EG system capacity for the network category, connection service type and basic EG system type being proposed for the connection service. The maximum system capacities of Table 4.1 and Table 4.2 for multi-phase basic EG Systems shall be the total capacity balanced across all phases.

The maximum basic EG system capacity is based on the connection service and connection point that the User has for their electrical installation.

Table 4.1: Maximum System Capacities for Large network category

Connection service (Large Networks)	Basic EG system phase	Maximum basic EG system capacity			Export limit[3] [4]
		Single energy source (i.e. no BESS)	DC coupled with BESS[1]	AC coupled with BESS[2]	
Single-phase	Single-phase	5 kVA	5 kVA	5 kVA PV (or other energy source IES) and 5 kVA BESS IES	5 kW
Three-phase	Single-phase	3 kVA	5 kVA	3 kVA PV (or other energy source IES) and 5 kVA BESS IES	5 kW
Three-phase	Three-phase	15 kVA	15 kVA	15 kVA PV (or other energy source IES) and 15 kVA BESS IES (up to 5 kVA per phase)	1.5 kW Except where PV (or other energy source IES) capacity ≤ 5kVA then 5 kW export limit

Notes:

(1) DC coupled refers to multiple energy sources (including Energy Storage systems) into the DC side of a single inverter.
(2) AC coupled refers to systems with multiple inverters for various energy sources (commonly PV) and energy storage systems. AC coupled systems may also have generation limit control requirements (refer section 4.3.2).
(3) For systems where export limit is equal to or greater than the system capacity no control based on external measurement is required (refer section 4.3.1).
(4) Where a User does not have an off-take agreement with their energy retailer their basic EG system shall have an export limit setting of no more than 1.5 kW.

Table 4.2: Maximum System Capacities for Small network category

Connection service (Small networks)	Basic EG System Phase[5]	Maximum basic EG System capacity			Export limit [3][4] [6]
		Single energy source (i.e. no BESS)	DC coupled with BESS[1]	AC coupled with BESS[2]	
Single-Phase	Single-phase	5 kVA	5 kVA	5 kVA PV or other energy source IES and 5 kVA BESS IES	3 kW
Split-phase	Single-phase	1.5 kVA	5 kVA	1.5 kVA PV or other energy source IES and 5 kVA BESS IES	1.5 kW
Split-phase	Split-phase (Two single-phase inverters)	6 kVA (3 kVA per phase)	6 kVA (3 kVA per phase)	6 kVA PV or other energy source IES and 6 kVA BESS IES (3 kVA per phase)	1.5 kW
Three-phase	Single-phase	3 kVA	5 kVA	3 kVA PV or other energy source IES and 5 kVA BESS IES	3 kW
Three-phase	Three-phase	10 kVA	10 kVA	10 kVA PV or other energy source IES and 10 kVA BESS IES (up to 5 kVA per phase)	1.5 kW Except where PV (or other energy source IES) capacity ≤ 5kVA then 3 kW export limit

Notes:

(1) DC coupled refers to multiple energy sources including Energy Storage systems into a single inverter on the DC side of the inverter.

(2) AC coupled refers to systems with multiple inverters for various energy sources (commonly PV) and energy storage systems. AC coupled systems also have generation limit control requirements (refer 4.3.2).

(3) For systems where export limit is equal to or greater than the system capacity no control based on external measurement is required (refer section 4.3.1).

(4) Listed Export limits are based on the most common small network connection arrangements, for example single-phase and split-phase typically connected to 10 kVA transformers. For these small networks the export limit may be decreased/increased as a result of the technical studies (refer Section 2.1).

(5) Technical studies are required for all basic EG systems on small network category

(6) Where a User does not have an off-take agreement with their energy retailer their basic EG system shall have an export limit setting of no more than 1.5 kW

4.2.2 Phase balance

The nominal inverter output rating of a split-phase or three-phase basic EG system connection shall be balanced across all phases.

On Large networks, the maximum imbalance permitted between any two phases shall be no more than 3 kVA in any combination of rating and operation of the basic EG system.

On Small networks that are split-phase, the maximum imbalance permitted between any two phases shall be no more than 1.5 kVA in any combination of rating and operation of the system.

For a multi-phase connection service, where the basic EG system includes a BESS, the BESS shall be balanced across all phases for BESS capacities greater than 5 kVA. Where a single-phase basic EG system with BESS either DC or AC coupled is connected on a three-phase connection service they shall be on same phase as the load it is intended to supply whilst also maintaining site load balance for all modes of operation (i.e. charging and generation).

4.3 Generation Control Functions

4.3.1 Export Limits at Connection Point

4.3.1.1 General

The export limit control function is used to limit the export through the User connection point to the grid.

The export limit for each category of basic EG system is provided in Table 4.1 and Table 4.2. The export limit shall be interpreted as soft, consistent with the definition of soft export limits within AS/NZS 4777.1 and AS/NZS 4777.2. For multi-phase connection services with balanced multi-phase basic EG systems the export limit shall be a net export limit across all the phases. For single-phase inverters on any multi-phase connection service additional balance requirements apply (refer 4.2.2).

This export limit shall be interpreted by the User as a maximum. The ability of the User's basic EG system to export at the export limit is not guaranteed, but rather, it will depend upon network characteristics that change over time. The output of a basic EG system may need to be constrained for various scenarios (and hence reducing export below limit) including, but not limited to scenarios where power quality response modes are in operation.

Where export limitation settings can be changed via a keypad or switches, adequate security must be employed to prevent any tampering / inadvertent / unauthorised changes. Suitable locks or a password system shall be used.

Where a User does not have an off-take agreement with their energy retailer their basic EG system shall have an export limit setting of no more than 1.5 kW. This is independent of any requirement in this section that may allow a larger export limit to be applied.

4.3.1.2 Large networks

The maximum export limit for basic EG Systems connecting within the Large network is listed in Table 4.1.

Basic EG systems that have the sum of inverter nameplate ratings where that sum is no more than 5 kVA for single and three-phase connection services on the Western Power Large network require no export limit or site generation limit.

4.3.1.3 Small networks

The maximum export limits for basic EG systems connecting within a Small network are listed in Table 4.2. In the Small network area, the basic EG systems are subjected to a technical assessment and may have a reduced export limit requirement based on that assessment.

Basic EG systems that have the sum of inverter nameplate ratings where that sum is no more than the export limit in Table 4.2 for single and split phase connection services on the Western Power Small network require no export limit or site generation limit (unless a reduced export limit has been assessed).

The export limit for three-phase basic EG systems shall be set equal to the required limit (Table 4.2) with a balanced output with respect to its rating and a tolerance of no more than 3 kVA unbalance between any phases at the connection point.

The export limit for split-phase basic EG systems shall be set equal to the required limit (Table 4.2) with a balanced output with respect to its rating and a tolerance of no more than 1.5 kVA unbalance between any phases at the connection point.

4.3.1.4 Additional requirements for BESS

In addition to the export limit, a basic EG System with BESS shall operate in accordance with Time of operation for BESS in section 4.3.3 of these requirements.

4.3.2 Site Generation Limit Downstream of Connection Point

The site generation limit downstream of the connection point shall be used where an AC coupled BESS is used with another IES (PV or other energy source). The site generation limit downstream of the connection point shall be the same as the AS/NZS 4777.2 soft limit for the generation limit control function.

The site generation limit for an AC coupled BESS and IES shall be the allowed maximum concurrent output level to the AC electrical installation from all inverter energy systems on the connection service.

For each connection service type and IES connection phases, there is a specific site generation limit. The specific site generation limits shall be as listed in Table 4.3 for each Connection service and IES phase.

Table 4.3: Generation limits

Connection service	IES	AC Coupled BESS	Site generation limit	Export limits[2]
Large network category				
Single-Phase	Single-phase	Single-phase	N/A[3]	Refer table 4.1
Three-Phase	Single-phase	Single-phase	N/A	Refer table 4.1
Three-Phase	Three-Phase[1]	Single-phase, two-phase or three-phase	15 kVA	Refer table 4.1
Small Network Category				

Connection service	IES	AC Coupled BESS	Site generation limit	Export limits[2]
Single-phase (Rural)	Single-phase	Single-phase	N/A	Refer table 4.2
Multi-phase (Rural)	Single-phase	Single-phase	N/A	Refer table 4.2
Two-Phase (Rural)	Two-Phase[1]	Single-phase or two-phase	6 kVA	Refer table 4.2
Three-Phase (Rural)	Three-Phase[1]	Single-phase, two-phase or three-phase	10kVA	Refer table 4.2

Notes:

(1) Multi-phase IES without BESS shall be balanced across all phases
(2) Table 4.1 and 4.2 define maximum capacities for basic EG systems and where required the export limits for the connection service.
(3) N/A – not applicable to these EG system types

4.3.3 Time of operation for BESS

The time of operation requirements have been determined based on typical residential and grid load patterns and are provided so that BESS can be managed in coordination with typical grid operation.

The time-band between 10 am to 3 pm all basic EG systems with BESS shall not discharge the BESS.

The time-band between 6 pm to 9 pm all basic EG systems with BESS shall not charge the BESS from the grid.

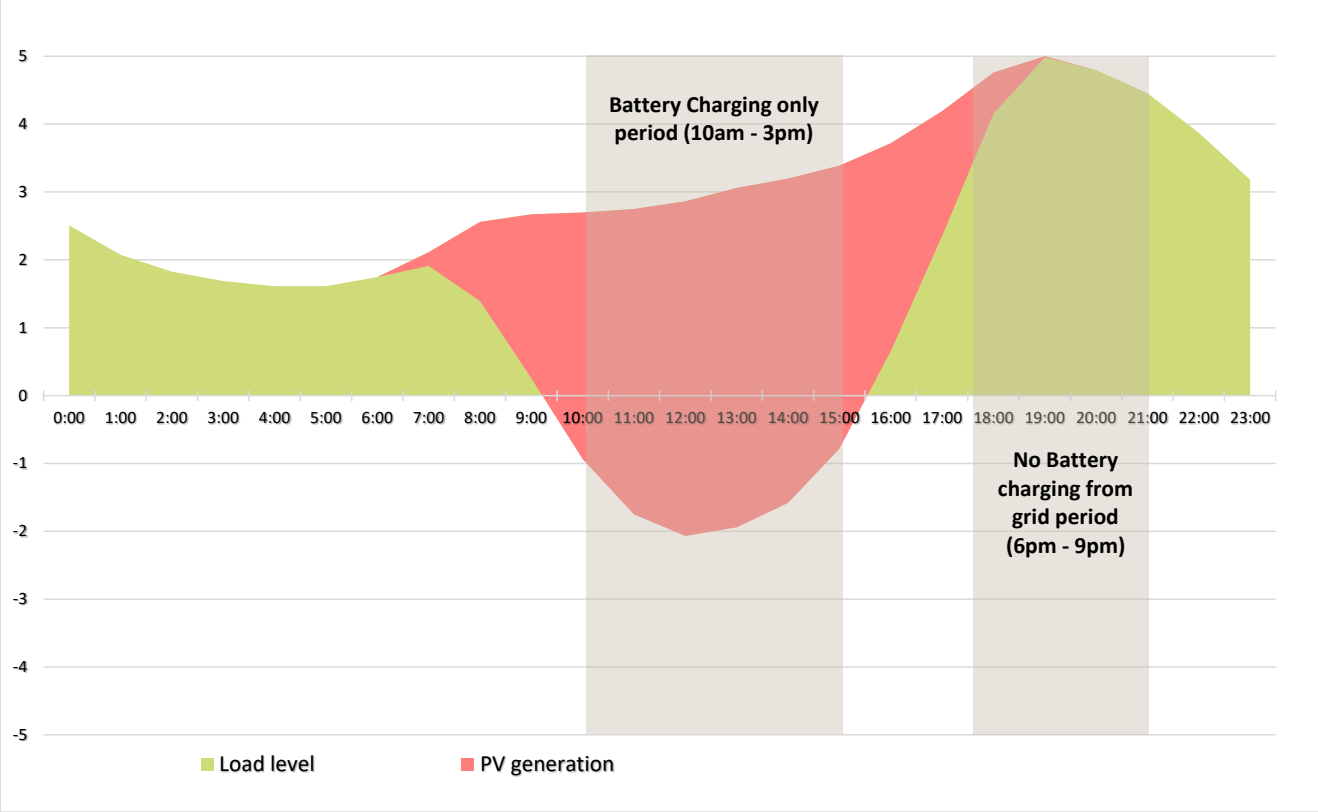
In addition to the time bands (10 am to 3 pm and 6 pm to 9 pm), the following operational behaviour of BESS on the grid is recommended to maximise utilisation of BESS in conjunction with another energy source:

i. Between 6 am to 10 am BESS should avoid charging during this time if BESS storage level is greater than 50%.
ii. Between 3 pm to 9 pm BESS may discharge from batteries (for net-load reduction).
iii. Between 9 pm and 6 am BESS may operate as required (charge or discharge).

The User may change the recommended operation times due to amount of storage available or load being supplied from grid.

Where the basic EG system is part of a virtual power plant (**VPP**) or has external control from a Distribution System Operator (**DSO**), the control or external signals originating from these are prioritised over the time of operation for BESS.

Figure 4.1: Example load and IES generation profile with time of operation for an BESS shown



4.3.4 DER management

Basic EG systems with a PV inverter rated at 5 kVA or less shall be able to be remotely disconnected from, and reconnected to, Western Power's distribution grid as directed by Western Power via an Authorised Agent in accordance with the Western Power Technical Rules. Other User's with a larger EG system or different energy sources may choose to have this functionality as part of an agreement with an Authorised Agent, in this case they shall conform with all DER management requirements.

A User shall have and maintain a system that provides the capability to be remotely disconnected from, and reconnected to, Western Power's distribution grid.

The minimum functionality shall include the ability to remotely disconnect from and reconnect to the grid. In addition to this minimum functionality, it is recommended that a User EG system is configured to enable reduction of exported real power to zero power (0 kW). It is recognised that in this case there will possibly be some export at times (short periods < 15 s) depending on variation of load and ability of inverter to respond.

The following descriptions provides minimal functional requirements through an Authorised Agent for methods that may be allowed:

a. A Western Power meter configured and wired such that on receipt of a signal the electricity meter can disconnect or reconnect the Basic EG system only from the distribution grid.

b. A communication channel to an Inverter system, such that the inverter can receive a signal from an Authorised Agent that shall initiate a disconnect and initiate a reconnect. In addition, the inverter may receive a signal from an Authorised Agent that may cause export of energy to the grid to cease or to resume.

c. A communication channel to a device, such that the device can receive a signal from an Authorised Agent that shall initiate a disconnect and initiate a reconnect of the basic EG system. In addition, the basic EG system may receive a signal from an Authorised Agent that may cause export of energy to the grid to cease or to resume.

d. A device connected to the DRM port of an inverter, which on receipt of a signal from an Authorised Agent - asserts a DRM0 signal to the inverter – causing the inverter to operate its disconnection device. When the signal is no longer asserted the inverter reconnects.

e. A device connected to the DRM port of an inverter, which on receipt of a signal from an Authorised Agent – asserts a DRM5 signal to the inverter – causing the inverter to cease to generate. When the signal is no longer asserted the inverter resumes generation.

The above methods are provided such that if utilised by a User and the Authorised Agent they are considered to conform to the requirements for this capability. Users and Authorised Agents that may have a methodology that is not listed above, may propose these to Western Power for consideration and approval prior to the application for a basic EG system connection.

For all acceptable methods, the remote reconnect signal allows the basic EG system to reconnect in conformance to AS/NZS4777.2 reconnection requirements.

For a basic EG system with a BESS the functionality requirement is for curtailment of export to the grid from any generation source.

An Authorised Agent method shall be approved by Western Power before providing services to Users. As at publication, an Authorised Agent only refers to Synergy.

The implementation of DER management becomes mandatory for basic EG systems applied for from 14 February 2022 or installed from 14 March 2022.

4.4 Inverter Energy System

4.4.1 General

The following requirements apply to inverter energy systems:

a. The User shall ensure that the basic EG system is compatible with the characteristics of Western Power's supply as defined in Section 2 of the Western Power Technical Rules.

b. The User must ensure that the basic EG system complies with AS/NZS 4777, IEC 62109 and the relevant electrical safety standard for the IES components.

c. IES shall comprise of inverters installed in compliance with AS/NZS 4777.1

d. The inverter shall be tested by an authorised testing laboratory and be certified as being compliant with AS/NZS 4777.2

e. IES shall comprise of inverters that are registered with CEC as approved grid connect inverters. The CEC inverter listing shall not have expired at the time of connection application and IES installation.

f. IES shall comprise of inverters that are tested by an authorised testing laboratory and certified as being compliant with AS/NZS IEC 62116 for active anti-islanding protection as per AS/NZS4777.2

g. IES shall comprise of inverters that have both volt-var and volt-watt response modes available and enabled.

h. Western Power may require the User to update inverter settings upon request.

Appendix A provides operational and protection settings for existing Basic EG systems and new Basic EG systems in accordance with AS/NZS 4777 standard series applicable at time of applications and installations. Appendix A also provides additional inverter requirements not covered by AS/NZS 4777.2:2015 for VDRT for EG system inverters installed prior to 18th December 2021.

4.4.2 Electric Vehicles

Electric vehicles that are only capable of charging from the grid are not considered a basic EG system but rather a load only and are subject to the requirements of the WASIR.

An electric vehicle shall be considered a Basic EG System, where:

a. it is capable of exporting energy into the User's premises but not the Distribution System, resulting in a Minimal-export configuration (also referred to as Vehicle-to-Building or V2B);

b. it is capable of exporting energy into the Distribution System, resulting in either a full- or Partial-export configuration (also referred to as Vehicle-to-Grid or V2G); or

c. the electric vehicle charger being installed has the capability to export electricity into either the User's premises or the Distribution System.

The inverters for these Electric Vehicles shall comply with all the Basic EG System technical requirements and AS/NZS 4777.2:2020. Where an electric vehicle is a basic EG system or part of a basic EG system it shall comply with time-based discharge requirements of section 4.3.3. Where an electric vehicle is a basic EG system or part of a basic EG system it should also conform to charge requirements of section 4.3.3.

Where the electric vehicle is part of a virtual power plant (VPP) or has external control from a Distribution System Operator (DSO) the control or external signals originating from these are prioritised over the time of operation for BESS.

4.5 Network Connection and Isolation

4.5.1 General

Network connection and isolation requirements for IES shall be as per WASIR, AS/NZS 4777.1 and AS/NZS 3000.

The basic EG system shall not have any devices that modify the voltage or frequency between the connection point and the grid-interactive port of the inverter.

The IES shall not have any voltage stabilisation devices between the connection point and the IES connection. These include any transformer based or power electronic based equipment that change the voltage level from the grid side of the device to the load or generation side of the device. These voltage stabilisation devices render important voltage-based safety functions in the inverter ineffective.

In all cases the connection service at the time of the basic EG system installation shall comply with WA Electrical Requirements (WAER), the WA Service and Installation Requirements (WASIR) (formerly the WA Distribution Connection Manual (WADCM)) and the Distribution Customer Connection Requirements (DCCR).

The User shall not cause their electrical installation to be overloaded in any combination of basic EG system operation.

4.5.2 Approval to operate

The approval to operate a basic EG system to the Western Power grid will be deemed as given and recorded within Western Power systems once all requirements for application processes, e-notices, data collection and conformance to the basic EG connection technical requirements are confirmed by Western Power.

Where an EG system is identified as no longer conforming to these basic EG connection technical requirements or site-specific conditions of approval, the approval to operate will be cancelled until the basic EG system is made to conform to these requirements.

When Western Power remove the approval to operate for a basic EG system the User will be notified and provided reasons for the non-conformance that needs to be remedied. Actions to proceed will be communicated to the User and may include the disconnection of the basic EG system from the Western Power grid until conformance is confirmed.

4.5.3 Main Switch

For all installations that have a basic EG system, the User installation main switch shall be a circuit breaker rated in accordance with WASIR section 11.

Note: For additional guidance refer to AS/NZS 3000 clause 2.5.1.

Refer to Table 2.1 for the applicable connection service capacity.

For all electrical installations that do not have a circuit breaker as the main switch this shall be upgraded to a circuit breaker before connection of the basic EG system.

Where a Western Power AMI meter is used for DER management purposes, the main switch shall be installed with an additional pole for connection of the auxiliary function terminal of an AMI meter. The auxiliary function terminal may be used for either direct or indirect control of an EG system. The addition of the extra pole of the main switch does not increase the overall capacity of the connection service. The Distribution Customer Connection Requirements (DCCR) provides additional details on the approved wiring arrangements.

For a single-phase connection service, a 2-pole circuit breaker rated at the capacity of the connection service shall be used. Similarly, for a three-phase connection service a 4-pole circuit breaker rated at the capacity of the connection service shall be used.

4.5.4 Isolation of non-grid-interactive EG systems

Embedded Generators that are not an AS/NZS 4777.2 compliant inverter used for backup power shall:

(i) not be connected on the grid side of a basic EG system as defined by this technical requirement document;

(ii) have interlocks that prevent the non-AS/NZS 4777 EG operating in parallel with the grid;

(iii) disconnect the load from the grid before connection to the EG;

(iv) provide mechanical isolation;

(v) be able to be secured in open position where grid nor EG is connected to the site load; and

(vi) provide isolation from grid to energy sources.

Stand-alone inverters not compliant with AS/NZS 4777.2 shall not be connected within an electrical installation connected to the Western Power grid unless approved by Western Power. This specifically refers to connection of the Western Power grid to the AC input ports of these stand-alone inverters usually provided for small electrical rotating generators.

Note: A stand-alone inverter will be required to be in accordance with AS/NZS 4777.2:2020 to be connected to Western Power. Listing and certification requirements are still being developed.

The following shall be considered as EG Systems and will be required to comply with the EG System technical requirement:

a. A Generating Unit connected behind a make-before-break switch that results in a momentary, or longer, connection between grid supply and Generation supply circuits when performing a changeover (these are covered in the LV EG Connection requirements).

b. A multiple mode inverter with uninterruptible power supply (UPS) mode functionality that is Grid Connected but also supplies an Off-grid circuit (basic EG system connection technical requirement maximum capacities apply) .

4.6 Earthing

The earthing requirements for basic EG connections shall include:

a. For **IES**, earthing requirements shall be as per AS/NZS 4777.1 and AS/NZS 3000

b. For BESS, earthing requirements shall be as per AS/NZS 5139.

c. For **PV** systems, earthing requirements shall be as per AS/NZS 5033.

4.7 Protection

4.7.1 Inverter integrated protection

Inverter integrated protection requirements shall be as per AS/NZS 4777.2 for basic EG system connections. For all Inverters conforming to AS/NZS 4777.2 the default regional setting selection shall be "Australia B".

Passive anti-islanding requirements and limit values shall be as per AS/NZS 4777.2.

Active anti-islanding protection requirements shall be as per AS/NZS 4777.2 with the test method required being to AS/NZS IEC 62116. The Active anti-islanding detection method shall be available on request for review by Western Power.

For inverters connected to the Western Power network the maximum voltage set point ($V_{nom\text{-}max}$) for Sustained operation for voltage variations as per AS/NZS 4777.2 shall be 258 V.

4.7.2 Central protection

Central protection according to AS/NZS 4777.1 shall not be required for basic EG systems.

4.7.3 Interlocking

Where multiple single-phase inverters are connected to more than one phase they shall operate as a balanced three-phase or split-phase generator with the allowed imbalance of section 4.2.2.

Where either one or more single-phase inverters are connected in combination with three-phase inverters on a standard connection service then maximum allowed imbalance of generation between any two phases shall be according to the requirements of section 4.2.2.

4.8 Operating Voltage and Frequency

Western Power's supply characteristics are defined in Section 2 of the Western Power Technical Rules.

The User shall be responsible for ensuring that the maximum voltage rise within the Premises complies with AS/NZS 4777.1 and provide a record of measurements or calculations as evidence in User documentation and retain evidence for Western Power's use or inspection. This is measured or calculated based on maximum output power with no power quality response modes included into calculations.

4.9 Power Quality

4.9.1 General

Power quality relates to the voltage level, voltage fluctuations and voltage distortion supplied to or experienced at a connection point.

The settings required for this power quality clause are for coordinating the operation of the IES with the expected characteristics of the grid at any connection point on the Western Power grid.

4.9.2 IES Power Quality response modes

4.9.2.1 General

AS/NZS 4777.2 provides requirements for various Power Quality response modes for inverters.

All basic EG Systems connected to Western Power shall have the following modes enabled:

a. Volt-var mode
b. Volt-watt mode
c. Power rate limit

Other power quality response modes are available as per AS/NZS4777.2, however, these will not be required for a basic EG system and shall be disabled.

4.9.2.2 Volt-var mode

All inverters shall have Volt-var mode enabled by default.

Volt-var mode shall be as per , with the following settings shown in the Table 4.4.

Table 4.4: Western Power volt-var settings

Reference	Voltage	Set-Point value (2) (var/rated VA %)	Type
V_{V1}	205	30%	Var source/supply or generator
V_{V2}	220	0%	
V_{V3}	235	0%	
V_{V4}	255	40%	Var sink/absorption or load

Notes:

(1) Var sink is in the direction to the inverter from the grid (-ve), Var source is in the direction from the inverter to the grid (+ve)
(2) The set-point value is the level of var required to be provided for the voltage measured by the inverter. This may reduce the active power level below the maximum level for the volt-watt mode.

4.9.2.3 Volt-watt mode

All inverters shall have Volt-watt mode enabled by default.

Volt-watt mode shall be as per AS/NZS 4777.2, with the following settings shown in Table 4.5.

Table 4.5: Western Power volt-watt settings

Reference	Voltage	Set-Point value (2) (W/rated VA%)
V_{W1}	250	100%
V_{W2}	260	20%

Notes:

(1) The set-point value is the maximum permitted active power output level for the voltage measured by the inverter

4.9.2.4 Power rate limit

All inverters are required to have a Soft Ramp Up after Connect or Reconnect mode as per AS/NZS 4777.2.

Western Power only requires soft ramp up to be applied to connection or reconnection (i.e. ramp up / soft start).

The ramp up power rate limit shall be: W_{Gra+}=16.67% of rated power per minute.

4.9.2.5 BESS power quality modes

A BESS inverter is a multiple mode inverter as per AS/NZS 4777.2.

The required voltage response is dependent on the energy storage level and required mode (e.g. fully charged status battery can discharge and generate but won't be able to charge to act as a load).

For a BESS inverter the Volt-watt mode shall be enabled for charging through the grid-interactive port of a multiple mode Inverter in conformance to AS/NZS 4777.2.

For a BESS inverter the Volt-watt mode shall be enabled for generation through the grid-interactive port of the multiple mode Inverter in conformance to AS/NZS 4777.2.

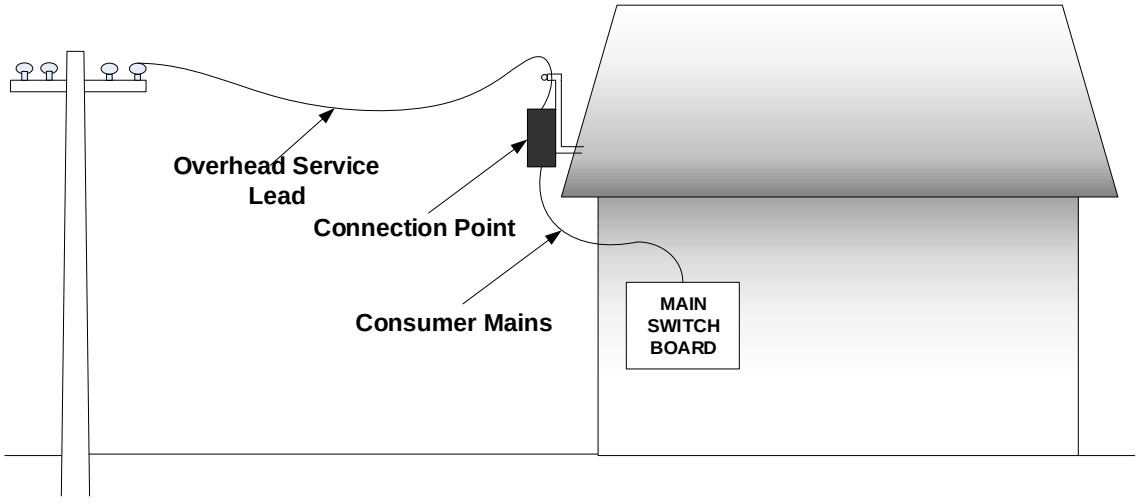
Requirements of section 4.9.2.2 volt-var mode shall apply to the charging mode of inverters with BESS.

4.9.3 Voltage rise

The User shall be responsible for ensuring that the maximum voltage rise within the Premises complies with AS/NZS 4777.1 and provide a record of measurements or calculations as evidence in User documentation and "retain" evidence for Western Power's use.

The maximum voltage rise from the connection point (i.e. on the service cable, Figure 4.2) to the LV street mains shall not exceed 1%. This should be determined by User for overhead LV network connections. Western Power standard overhead service leads are 6mm^2 copper **XLPE** cable.

Figure 4.2: Example Service lead and Connection point on typical overhead connection service



4.10 Communication Systems

Inverter EG System shall comprise of inverters that have internet capability and an on-board communication port that can be used for a physical connection to another device (eg. via RJ45, USB and RS-232) or a Wi-Fi connection. Internet capability and an on-board communication port are minimum infrastructure requirements to enable communication between inverter energy systems and Authorised Agents enabling EG systems to potentially participate in DER management.

The User shall maintain User owned communications link and functionality that are used to provide DER Management Functionality via an Authorised Agent.

4.11 Cybersecurity

Western Power shall notify the User of any cybersecurity requirements, which may include:

a. Monitoring and communications devices shall be in screw sealed or lockable enclosures;
b. Protection and control from the network systems (firewalls);
c. Privilege settings and password protection;
d. Limiting access to only that which is required to monitor the generating unit;
e. Communications shall be over secured channels or Modbus TCP; or
f. No unauthorised changes to the communications device .

4.12 Technical Studies

No technical studies for connection of basic EG systems pertaining to the Western Power network are required to be carried out by the User to enable connection to the distribution network.

Technical studies may be performed by Western Power. The outcomes of the technical studies shall not result in any change to the published technical requirements for basic EG system connections. Technical studies where required (typically only for small network category refer Table 4.2) will be used to determine the capacity of the connection point for the connection of the proposed basic EG system. These studies may include voltage rise calculation across the LV network and evaluation of network capacity.

Where a Technical Study is performed and identifies the requirement for any generation or network augmentation, or augmentation of the User's EG system to facilitate the EG connection then this will be at the User's cost. The export limit for a User's basic EG system will be reduced before a requirement for augmentation of the network is required.

4.13 Metering

This section refers to Western Power's requirements for the supply, installation and maintenance of metering and service equipment. The requirements of the WASIR metering section shall apply and be read in conjunction with the Electricity Industry (Metering) Code and the WAER.

Western Power metering will be used by Western Power to monitor net exports in compliance with this document. Exceeding export levels can result in systems being disconnected until the export limit is implemented in conformance to basic EG system requirements.

4.14 Labelling and Signage

The labels and signs on the installation, including cables, shall be as per Australian Standards of Table 3.1.

5. Fees and Charges

Western Power does not have fees and charges currently for basic EG Systems applications. However, additional costs could be incurred in the event the Technical Assessment identifies the requirement for any generation or network augmentation, communications, or augmentation of the User's EG system required to facilitate the EG connection.

6. Testing and Commissioning

Testing and commissioning shall be undertaken to demonstrate that the basic EG system meets the requirements of this document and the conditions of connection approval for the User EG System Connection.

Commissioning and verification shall be in accordance with AS/NZS 4777.1, AS/NZS 3000, AS/NZS 3017 and AS/NZS 5033 (where applicable), the equipment manufacturer's specifications, and requirements as outlined in this document.

Commissioning and testing shall include (but not limited to):

a. Confirmation that the export limiting device prevents export above set limit for more than 15 s;

b. Confirmation that the generation limiting device prevents BESS and IES from exceeding the set limit;

c. Confirmation that imbalance between phases is no more than the allowed level for basic EG Systems; and

d. Confirmation that the EG system is connected via an approved functional method to an Authorised Agent's DER management system.

Prior to completion of the basic EG system commissioning, or whenever the system is modified, a verification test shall be performed as recommended by the equipment manufacturer and required by the relevant standard. Testing of the basic EG system shall include procedures to functionally test all protective elements including verification of inverter trip timing.

Western Power reserves the right to witness commissioning or request evidence of commissioning results.

If requested, the User will provide to Western Power a list of step-by-step energizing and commissioning procedures prior to basic EG system commissioning.

The User shall retain a complete set of manuals, installation drawings; permits, inspection, and verification test reports; full list of applied operational settings and make them available to Western Power if requested.

The tests shall be installation tests and functional tests, not type tests.

A User shall cooperate with an Authorised Agent and confirm that the conditions of connection approval have been met, including:

(i) System is same as approved;

(ii) System capacity information (including maximum permitted export);

(iii) Confirmation of correct configuration, settings and compliance with Western Power condition of connection approval; and

(iv) DER management correctly installed and commissioned.

A User shall provide relevant and requested system data after installation at completion of the basic EG system commissioning that indicates all conditions of approval have been met, including commissioning of DER management systems have been completed. Western Power will publish information on how this information will be collected.

7. Operation and maintenance

7.1 User obligations

Basic EG systems shall be operated and maintained to ensure compliance with their connection agreement and all legislation, codes, other regulatory instruments, and these EG Connection Technical Requirements at all times.

Operations and maintenance requirements for basic EG systems shall include, but not be limited to:

a. Maintaining the electrical installation at the connection service address in a safe condition.

b. Ensuring that any changes to the electrical installation at the supply address are performed by an electrician lawfully permitted to do the work and that the User holds a Certificate of Compliance issued in respect of any of the changes.

c. The User shall seek Western Power approval prior to altering the EG system connection in terms of an addition, upgrade, extension, expansion, augmentation or any other kind of alteration, including changing inverter settings.

d. The User shall maintain connectivity to an Authorised Agent's system used for DER management.

7.2 Compliance audits

The EG system shall comply with these EG Connection Technical Requirements and the conditions of connection approval at all times, until it is permanently disconnected. The User shall notify Western Power when the EG is permanently disconnected.

Western Power may inspect or audit the User's basic EG system at any time for compliance with the requirements of this Document. Western Power may perform an audit either by a site visit to a User's premises, via analysis of data or other means.

Compliance audits of existing EG systems connected prior to this version of the EG Connection Technical Requirements may also be undertaken; these systems shall be assessed against the version of the EG Connection Technical Requirements at the time the system was approved to connect to the grid.

Western Power shall contact the User to arrange for an audit of the EG system at their Premises prior to the proposed audit date. The User shall provide full unrestricted access to the EG system to the Western Power personnel or authorised Western Power contractor undertaking the audit.

The results of the audit shall be recorded on Western Power's system for future reference.

Any non-compliance with the Technical Requirements identified during an audit shall result in the EG system being disconnected from Western Power's network and a Fault Note being placed on the installation. The EG system shall not be reconnected to the grid until Western Power is satisfied that the non-compliance has been resolved. Rectification of non-compliance issues shall be at the User's cost.

The frequency for audits shall not be more than once per year, with exceptions where non-compliance has previously been identified for the EG connection at the same Premises.

These compliance audits are separate/different to electrical inspections performed by WA Electrical Inspectors under the Energy Coordination Act 1994.

Appendix A

Inverter settings for all installations

Normative

A.1 Inverter Standards applicability to new and existing installations

This appendix includes the inverter settings and requirements for new basic EG systems installed after publication of this Basic EG Connection Technical Requirement document, for purposes of installation and confirming compliance of installation when audits, maintenance or changes are being performed.

This appendix also includes the inverter settings and requirements for existing basic EG systems installed prior to the publication of this Basic EG Connection Technical Requirement document for purposes of confirming compliance of existing installation when audits, maintenance or changes are being performed.

Where an existing installation is being upgraded, the existing parts of the installation that are not to be changed shall be made compliant with the connection requirement at time of the original installation.

Where an existing basic EG system installation's inverter requires replacement (with no other modifications to energy source or other components) then the following applies:

a. A like for like replacement is to be installed to replace an inverter compliant to AS/NZS 4777.2:2005 and AS/NZS 4777.3:2005 then the replacement inverter shall be the same brand and model with settings as per original installation date requirements (refer A.4).
b. Where a like for like replacement is to be installed to replace an inverter compliant to AS/NZS 4777.2:2015 then the replacement inverter shall be same size and additionally capable of volt-var, VDRT requirements and be configured with the settings according to requirements current at 1st July 2021 as per A.3.
c. Where a like for like replacement is not available then a current model inverter (shall be same size ± 0.1 kVA) shall be used as the replacement inverter and conforms with requirements applicable at time of the replacement inverter installation.
d. Where a like for like replacement is not available and the inverter size is changed, a new application is required and shall conform to all current requirements.
e. As part of the replacement installation the latest firmware shall be applied to the replacement inverter, and the use of setting to the 'Australia Region B' setting shall be implemented.

All IES connected to the network must comply with the AS/NZS 4777 series of standards.

For Basic EG systems connected between 1 July 2021 and 18 December 2021, the inverter, in addition to being compliant with AS/NZS 4777.2:2015, shall be compliant with Short Duration Under Voltage Disturbance ride-through test procedure published by AEMO. Refer to https://aemo.com.au/-/media/files/electricity/der/2021/vdrt-test-procedure.pdf?la=en

Table A.1 lists applicable inverter energy system standards, together with their validity dates.

Table A.1: Standard series AS/NZ4777 Grid connection of energy systems via inverters

Part	Part Name	Version	Comments
AS4777.1	Installation requirements	2005	Superseded by AS/NZS 4777.1:2016
AS4777.2	Inverter requirements	2005	Superseded by AS/NZS 4777.2:2015 9th October 2016
AS 4777.3	Grid protection	2005	Superseded by AS/NZS 4777.2:2015 9th October 2016
AS/NZS 4777.1	Installation requirements	2016	Current
AS/NZS 4777.2	Inverter requirements	2015	Superseded by 2020 version 18th December 2021
AS/NZS 4777.2	Inverter requirements	2020	Current and includes Amendment 1

A.2 AS/NZS 4777.2 2020

For all Basic EG Inverters conforming to AS/NZS 4777.2:2020 the default regional setting selection shall be "Australia B".

For all other modes and operation that are not covered by a regional setting then requirements of the relevant section of this document apply. Typically, they are the default settings of AS/NZS 4777.2 2020.

For DER Management, an inverter may require connection to activate Inverter demand response modes as per AS/NZS 4777.2:2020 clause 3.2. This may use DRM 0 or DRM 5.

A.3 AS/NZS 4777.2 2015

Table A.2 lists Western Power's requirements for the use of additional inverter functionality and values for set-points required for inverters, in accordance with AS/NZS 4777.2:2015 installed up to 18 December 2021.

The functions have configurable set-points that must be aligned to Western Power's required setting. Any requirement appearing in the standard that is not listed below must be applied as specified by the standard.

Requirement listed in Table A.2 apply to all inverters installed after 9th October 2016 (except where noted in table).

Table A.2: Required settings - inverters compliant with AS/NZS 4777.2:2015

Clause	Comment	Default setting	Western Power requirement
6.2	Inverter demand response modes	DRM 0 Disconnect - required.	*DRM 0 implemented as required by Western Power*
		DRM 1 to DRM 8 - optional.	DRM 1 to DRM 8 - not required.
6.3	**Power quality response modes**		

Clause	Comment	Default setting	Western Power requirement
6.3.2.2	Volt-watt response mode	Default - enabled. Tables 9 & 10 - default values.	Required and Enabled Tables 9 & 10 - default values.
6.3.2.3	Volt-var response mode	Default - enabled.	Required and Enabled Set points V1 =205 V, 30% (vars source) V2 = 220 V, 0% V3 = 235V, 0% V4 = 250, 30% (vars sink) **Note: applicable from 9th August 2019**
6.3.2.4	Voltage balance mode	Default - disabled.	Disabled. Optional for users with supplies > 100 A.
6.3.3	Fixed power factor mode and reactive power mode	Default - disabled.	Disabled.
6.3.4	Power factor curve -Cos Φ (P)	Default - disabled.	Disabled.
6.3.5 (6.3.5.3.2 & 6.3.5.3.3)	Power rate limit Note: This will be applied to reconnection (i.e. ramp up/soft start).	Required. Default ramp time W_{Gra}=16.67% T_n=6 minutes	Required. W_{Gra} or W_{Gra}+ = 16.67% Tn+=6 minutes W_{Gra}-=50% T_n-=2 minutes
Protective functions for connection to electrical installations and the grid			
7.3	Active anti-islanding protection	Either test methods of Appendix F or IEC 62116.	Test method to IEC 62116 is required.
7.5.2	Sustained operation for voltage variations	Required. Default setting $V_{nom-max}$ = 255 V	Required. Default setting $V_{nom-max}$ = 258 V
7.5.3	Sustained operation for frequency variations (generation operation).	Required. Default setting F_{stop}=52 Hz	Required. Default setting F_{stop}=51.5 Hz
7.6	Disconnection by external signal.	Required.	Required. Note: while this capability is a requirement for inverters, this function is generally only implemented for larger systems (> 200 kVA) where an inter-trip is required.
Additional requirements for multiple mode inverters			

Clause	Comment	Default setting	Western Power requirement
6.3.5.3.4	Changes in energy source operation. Note: For multiple mode inverters (i.e. with energy storage) will also apply for changes in energy source operation.	Default - disabled.	Required and Enabled. For changes in energy generation and consumption through grid-interactive port.
6.4.3	Volt-watt response mode for charging of energy storage	Required.	Required and Enabled Set points V1 =205 V, 0% (charging load) V2 = 220 V, 100% (charging load) V3 = 235V, 100% V4 = 250, 100% Note: Table 9 and Table 12 values have been modified.
7.5.3	Sustained operation for frequency variations (charging operations)	Required. Default setting F_{stop}-CH=49 Hz	Required. Default setting F_{stop}-CH=49 Hz

A.4 AS 4777.2:2005 and AS4777.3:2005

This section summarises the requirements that must be used for existing IEG connected to the Western Power network prior to 9th October 2016.

Inverters compliant with the superseded 2005 version have adjustable set-points. For existing installations where an addition or alteration is made and the original inverter is retained, Western Power requires these inverter set-points to be changed to align to its requirements and those of AS/NZS 4777.2:2015. The required settings are listed in Table A.3.

Table A.3: Required settings - inverters compliant with AS/NZS 4777.3:2005

AS 4777.3:2005 clause 5.3	Range	Required setting
Under-voltage, V_{min}	200 - 230 V	200 V
Over-voltage, V_{max}	230 - 270 V	265 V
Under-frequency, F_{min}	45 - 50 Hz	47 Hz
Over-frequency, F_{max}	50 - 55 Hz	51.5 Hz